LSC meeting

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Proposal for a Wireless Electrostatic Mirror Actuation (Marconi Project)

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Motivations for Marconi Project

- thermal noise induced on the mirrors by permanent magnets limits the interferometer sensitivity
- noise sources related to cabling

The proposed solution could solve both problems: less noisy actuation and clean signal transmission.

The system is based on AC electrostatic mirror actuation and wireless transmission of signal and power.

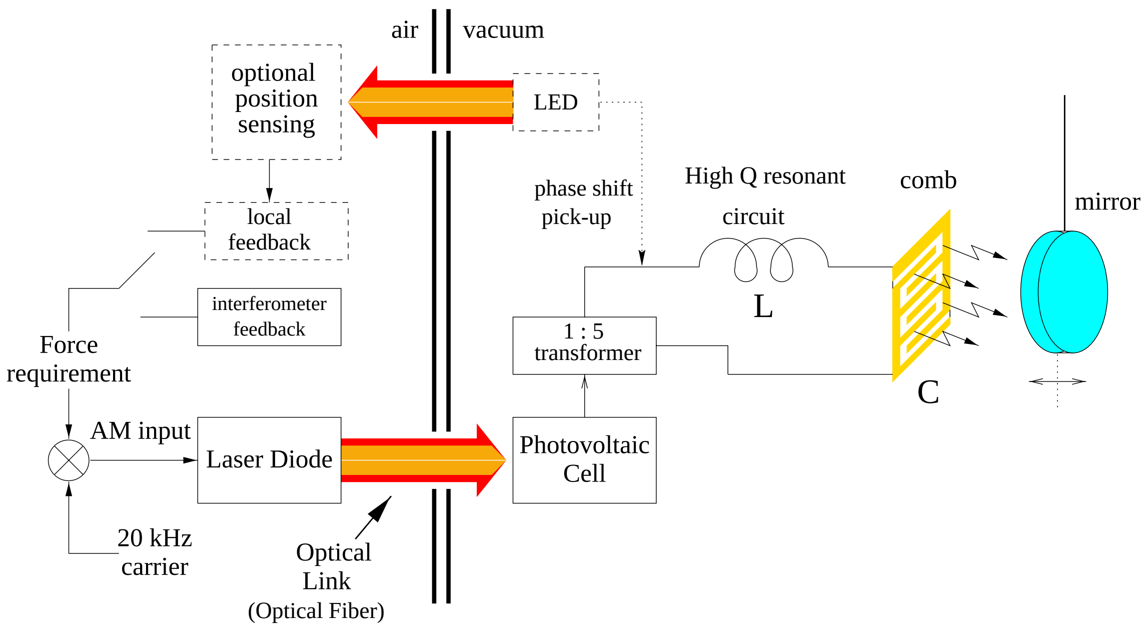
Besides, it offers the possibility of precision position sensing by resonator's phase shift r/o.

AC Advantages

- AC → stray charge $< f >= 0$
- AC field → $< E >= 0$ → less stray charge

In AC it's possible to take advantage of high Q resonator and transformer → direct drive signal via photodiode

Block Diagram of the System



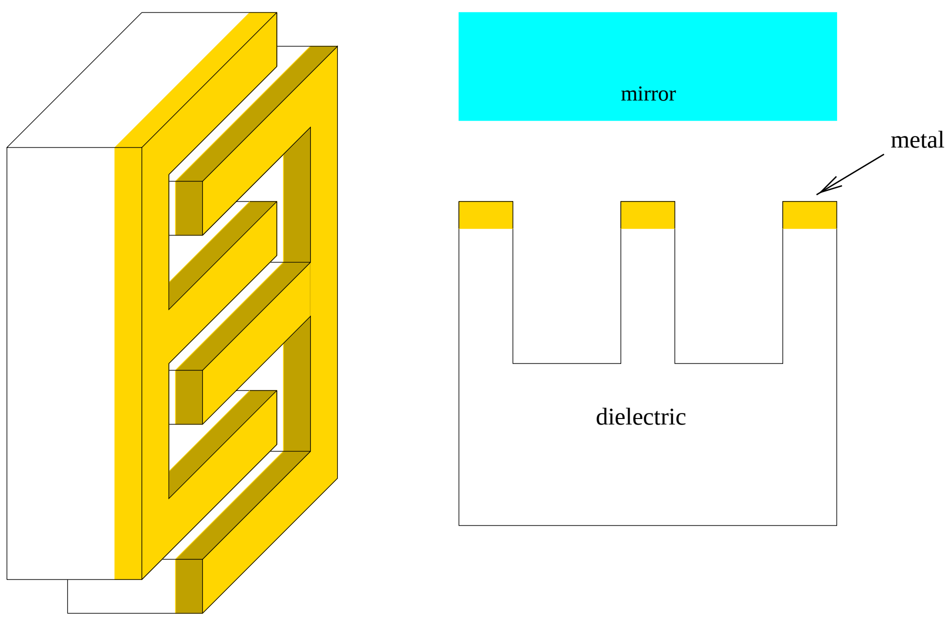
- optical transmission of power
- periodic array of metallic strip electrodes (the comb)
- completely passive actuation

The Actuator

$$C = G \, \epsilon_{eff}$$

where G is the comb's geometrical factor and ϵ_{eff}, the effective dielectric constant of the comb, is given by

$$\epsilon_{eff} = \alpha \, \epsilon_{subs} + \beta(x) \, \epsilon_{vac} + \gamma(x) \, \epsilon_{quartz}$$



An attractive force is obtained,

$$f(x) = \frac{\partial E(x,v)}{\partial x} = \frac{1}{2} \frac{C \, V^2}{x_0}$$

x_0 being the distance between capacitive actuator and mirror.

Achievements

$Q_{required} > \; 100 \quad @ \quad 30kHz$

Tested several ferrites and choke coiling schemes

Achieved

$Q = 60$ G10 comb

Q sensitive to ambient humidity

$Q = 230$ good capacitor

Designing new comb